

facet erosion: In laser diodes, a phenomenon in which a high field intensity of stimulated optical radiation causes degradation of the facets, *i.e.*, those forming the cavity mirrors, decreasing reflectivity and resulting in a decrease of the internal quantum efficiency and an increase in the threshold current.



facility: **1.** A fixed, mobile, or transportable structure, including (a) all installed electrical and electronic wiring, cabling, and equipment and (b) all supporting structures, such as utility, ground network, and electrical supporting structures. (188) **2.** A network-provided service to users or the network operating administration. **3.** A transmission pathway and associated equipment. **4.** In a protocol applicable to a data unit, such as a block or frame, an additional item of information or a constraint encoded within the protocol to provide the required control. **5.** A real property entity consisting of one or more of the following: a building, a structure, a utility system, pavement, and underlying land. [JP1]

facility grounding system: The electrically interconnected system of conductors and conductive elements that (a) provides multiple current paths to the earth electrode subsystem, and (b) consists of the earth electrode subsystem, the lightning protection subsystem, and the fault protection subsystem. (188)

facsimile (FAX): **1.** A form of telegraphy for the transmission of fixed images, with or without half-tones, with a view to their reproduction in a permanent form. In this definition the term telegraphy has the same general meaning as defined in the Convention. [NTIA] [RR] **2.** The process by which fixed graphic images, such as printed text and pictures, are scanned, and the information converted into electrical signals that may be transmitted over a telecommunications system and used to create a copy of the original, or an image so produced. (188) *Note 1:* Wirephoto and telephoto are facsimile via wire circuits. Radiophoto is facsimile via radio. *Note 2:* Technology now exists that permits the transmission and reception of facsimile data to or from a computer without requiring hard copy at either end. *Note 3:* Current facsimile systems are designated and defined as follows:

➤ **Group 1 Facsimile:** The mode of black and white facsimile operation, defined in CCITT Recommendation T.2, that uses double sideband modulation without any special measures to compress the bandwidth. *Note 1:* A 216 × 279-mm document, *i.e.*, an 8½ × 11-inch document, may be transmitted in approximately 6 minutes via a telephone-type circuit. Additional modes in this group may be designed to operate at a lower resolution suitable for the transmission of 216 × 279-mm documents in 3 to 6 minutes. *Note 2:* The CCITT frequencies used are 1300 Hz for white and 2300 Hz for black. The North American standard is 1500 Hz for white and either 2300 or 2400 Hz for black.

➤ **Group 2 Facsimile:** The mode of black and white facsimile operation, defined in CCITT Recommendation T.3, that accomplishes bandwidth compression by using encoding and vestigial sideband, but excludes processing of the document signal to reduce redundancy. *Note:* A 216 × 279-mm document, *i.e.*, an 8½ × 11-inch document, may be transmitted in approximately 3 minutes using a 2100-Hz AM/PM/VSB, over a telephone-type circuit.

➤ **Group 3 Facsimile:** The mode of black and white facsimile operation, defined in ITU-T Recommendation T.4, that incorporates means for reducing the redundant information in the signal by using a one-dimensional run-length coding scheme prior to the modulation process. *Note 1:* A 216 × 279-mm document, *i.e.*, an 8½ × 11-inch document, may be transmitted in approximately 1 minute or less over a telephone-type circuit with twice the Group 2 horizontal resolution. The vertical resolution may also be doubled. *Note 2:* Group 3 Facsimile machines have integral digital modems. *Note 3:* An optional two-dimensional bandwidth compression scheme is also defined within the Group 3 Facsimile Recommendation. *Note 4:* When any CCITT or CCIR Recommendation is modified by the ITU-T, the modified document is designated as an ITU-T Recommendation.

➤ **Group 3C Facsimile:** The Group 3 digital mode of facsimile operation defined in CCITT Recommendation T.30. *Note:* Group 3C is also referred to as Group 3 Option C or as Group 3-64 kb/s.

➤ **Group 4 Facsimile:** The mode of black and white facsimile operation defined in ITU-T Recommendation T.563 and CCITT Recommendation T.6. *Note 1:* Group 4 Facsimile uses bandwidth compression techniques to transmit, essentially without errors, a 216 × 279-mm document, *i.e.*, an 8½ × 11-inch document, at a nominal resolution of 8 lines/mm in less than 1 minute over a public data network voice-grade circuit. *Note 2:* When any CCITT or CCIR Recommendation is modified by the ITU-T, the modified document is designated as an ITU-T Recommendation.

➤ **Type I Facsimile:** The mode of digital black and white facsimile operation defined in MIL-STD-188-161 used for transmission of bi-level information (*e.g.*, text and simple graphics). *Note:* Type I facsimile is interoperable with the black-and-white facsimile mode of STANAG 5000 and is designed for operation over noisy communications links such as tactical channels.

➤ **Type II Facsimile:** The mode of gray-scale facsimile operation defined in MIL-STD-188-161 used for transmission of multi-level information (*e.g.*, photographs). *Note:* Type II facsimile is interoperable with the black-and-white facsimile mode of Type I or STANAG 5000 equipment and is designed for operation over noisy communications links such as tactical channels.

facsimile converter: **1.** In a facsimile receiver, a device that changes the signal modulation from frequency-shift keying (FSK) to amplitude modulation (AM). (188) **2.** In a facsimile transmitter, a device that changes the signal modulation from amplitude modulation (AM) to frequency-shift keying (FSK). (188)

facsimile frequency shift: At any point in a frequency-shift facsimile system, the numerical difference between the frequency that corresponds to a white signal and the frequency that corresponds to a black signal. *Note:* Facsimile frequency shift is usually expressed in hertz. [From Weik '89]

facsimile picture signal: In facsimile systems, the baseband signal that results from the scanning process. (188)

facsimile receiver: In a facsimile system, the equipment that converts the facsimile picture signal into a recorded copy. (188)

facsimile recorder: In a facsimile receiver, the device that performs the final conversion of the facsimile picture signal to an image of the object, *i.e.*, makes the recorded copy. (188)

facsimile signal level: In a facsimile system, the signal level at any point in the system. (188) *Note 1:* The facsimile signal level is used to establish the operating levels. *Note 2:* The facsimile signal level is usually expressed in dB with respect to some standard value, such as 1 mW (milliwatt), *i.e.*, 0 dBm.

facsimile transceiver: In a facsimile system, the equipment that sends and receives facsimile signals. (188) *Note:* Full-duplex facsimile transceivers can send and receive at the same time; half-duplex facsimile transceivers cannot.

facsimile transmitter: In a facsimile system, the equipment that converts the baseband picture signals, *i.e.*, the baseband signals resulting from scanning the object, into signals suitable for transmission by a communications system. (188)

fade margin: **1.** A design allowance that provides for sufficient system gain or sensitivity to accommodate expected fading, for the purpose of ensuring that the required quality of service is maintained. **2.** The amount by which a received signal level may be reduced without causing system performance to fall below a specified threshold value. *Synonym fading margin.*

fading: In a received signal, the variation (with time) of the amplitude or relative phase, or both, of one or more of the frequency components of the signal. *Note:* Fading is caused by changes in the characteristics of the propagation path with time. (188)

fading distribution: The probability distribution that signal fading will exceed a given value relative to a specified reference level. (188) *Note 1:* In the case of phase interference fading, the time distribution of the instantaneous field strength usually approximates a Rayleigh distribution when several signal components of equal amplitude are present. *Note 2:* The field

strength is usually measured in volts per meter. *Note 3:* The fading distribution may also be measured in terms of power level, where the unit of measure is usually watts per square meter and the expression is in dB.

fading margin: *Synonym* **fade margin.**

fail: *See* **failure, graceful degradation.**

fail safe: **1.** Of a device, the capability to fail without detriment to other devices or danger to personnel. (188) **2.** Pertaining to the automatic protection of programs and/or processing systems to maintain safety when a hardware or software failure is detected in a system. [NIS] **3.** Pertaining to the structuring of a system such that either it cannot fail to accomplish its assigned mission regardless of environmental factors or that the probability of such failure is extremely low.

fail-safe operation: **1.** Operation that ensures that a failure of equipment, process, or system does not propagate beyond the immediate environs of the failing entity. (188) **2.** A control operation or function that prevents improper system functioning or catastrophic degradation in the event of circuit malfunction or operator error.

failure: The temporary or permanent termination of the ability of an entity to perform its required function. (188)

failure access: [An] Unauthorized and usually inadvertent access to data resulting from a hardware or software failure in an AIS. [NIS]

fair queuing: The controlling of congestion in gateways by restricting every host to an equal share of gateway bandwidth. *Note:* Fair queuing does not distinguish between small and large hosts or between hosts with few active connections and those with many.

fall time: The time required for the amplitude of a pulse to decrease (fall) from a specified value (usually 90 percent of the peak value exclusive of overshoot or undershoot) to another specified value (usually 10 percent of the peak value exclusive of overshoot or undershoot). (188) *Note:* Limits on undershoot and

oscillation, *i.e.*, hunting, may need to be specified when specifying fall time limits. *Synonym* **pulse decay time.**

false character: *See* **illegal character.**

false clock: A condition where a phase-locked loop controlling a clock locks on a frequency other than the correct frequency. *Note 1:* False clock can occur when there is excessive phase shift, as a function of frequency, in the loop. *Note 2:* False clock often occurs where the false frequency is a harmonic of the correct frequency.

false lock: A condition where a phase-locked loop locks to a frequency other than the correct one, or to an improper phase.

fan-beam antenna: A directional antenna producing a main beam having a large ratio of major to minor dimension at any transverse cross section.

fan out: *Synonym* **break out.**

FAQ file: *Abbreviation for* **Frequently Asked Questions file.** An online file that contains frequently asked questions with answers provided to assist new users and avoid repetitive offline inquiries. *Note:* An *FAQ file* is usually created for Internet news groups, but is also used in other applications.

Faraday effect: A magneto-optic effect in which the polarization plane of an electromagnetic wave is rotated under the influence of a magnetic field parallel to the direction of propagation. *Note:* The Faraday effect may be used to modulate a lightwave.

far-end crosstalk: Crosstalk that is propagated in a disturbed channel in the same direction as the propagation of a signal in the disturbing channel. *Note:* The terminals of the disturbed channel, at which the far-end crosstalk is present, and the energized terminals of the disturbing channel, are usually remote from each other. (188)

far field: *Synonym* **far-field region.**

far-field diffraction pattern: The diffraction pattern of a source (such as an LED, ILD, or the output end of an optical fiber) observed at an infinite distance

from the source. *Note 1:* A far-field pattern exists at distances that are large compared with s^2/λ , where s is a characteristic dimension of the source and λ is the wavelength. For example, if the source is a uniformly illuminated circle, then s is the radius of the circle. *Note 2:* The far-field diffraction pattern of a source may be observed at infinity or (except for scale) in the focal plane of a well-corrected lens. The far-field pattern of a diffracting screen illuminated by a point source may be observed in the image plane of the source. *Synonym* **Fraunhofer diffraction pattern.**

Contrast with **near-field diffraction pattern.**

far-field radiation pattern: A radiation pattern measured at the far field of an antenna or other emitter.

far-field region: The region where the angular field distribution is essentially independent of distance from the source. (188) *Note 1:* If the source has a maximum overall dimension D that is large compared to the wavelength, the far-field region is commonly taken to exist at distances greater than $2D^2/\lambda$ from the source, λ being the wavelength. *Note 2:* For a beam focused at infinity, the far-field region is sometimes referred to as the Fraunhofer region. *Synonyms* **far field, far zone, Fraunhofer region, radiation field.**

far zone: *Synonym* **far-field region.**

fast packet switching: A packet switching technique that increases the throughput by eliminating overhead. *Note 1:* Overhead reduction is accomplished by allocating flow control and error correction functions to either the user applications or the network nodes that interface with the user. *Note 2:* Cell relay and frame relay are two implementations of fast packet switching.

fast select: An optional user facility in the virtual call service of CCITT X.25 protocol that allows the inclusion of user data in the call request/connected and clear indication packets. *Note:* Fast select is an essential feature of the CCITT X.25 (1984) protocol.

fault: **1.** An accidental condition that causes a functional unit to fail to perform its required function. **2.** A defect that causes a reproducible or catastrophic malfunction. *Note:* A malfunction is considered reproducible if it occurs consistently under the same

circumstances. **3.** In power systems, an unintentional short-circuit, or partial short-circuit, between energized conductors or between an energized conductor and ground. (188)

fault management: In network management, the set of functions that (a) detect, isolate, and correct malfunctions in a telecommunications network, (b) compensate for environmental changes, and (c) include maintaining and examining error logs, accepting and acting on error detection notifications, tracing and identifying faults, carrying out sequences of diagnostics tests, correcting faults, reporting error conditions, and localizing and tracing faults by examining and manipulating database information. (188)

fault protection subsystem: In a facility power distribution system, the subsystem that provides a direct path from each power sink to the earth electrode subsystem. (188) *Note:* The fault protection subsystem is usually referred to as a “*green wire.*”

fault tolerance: The extent to which a functional unit will continue to operate at a defined performance level even though one or more of its components are malfunctioning.

FAX: *Acronym for facsimile.*

FC: *Abbreviation for functional component.*

FCC: The U.S. Government board of five presidential appointees that has the authority to regulate all non-Federal Government interstate telecommunications (including radio and television broadcasting) as well as all international communications that originate or terminate in the United States. *Note:* Similar authority for regulation of Federal Government telecommunications is vested in the National Telecommunications and Information Administration (NTIA).

FCC registration program: The Federal Communications Commission program and associated directives intended to assure that all connected terminal equipment and protective circuitry will not harm the public switched telephone network or certain private line services. *Note 1:* The FCC registration program requires the registering of terminal equipment and protective circuitry in accordance with

Subpart C of part 68, Title 47 of the *Code of Federal Regulations*. This includes the assignment of identification numbers to the equipment and the testing of the equipment. *Note 2:* The FCC registration program contains no requirement that accepted terminal equipment be compatible with, or function with, the network. (188)

FCS: *Abbreviation for frame check sequence. See cyclic redundancy check.*

FDDI: *Abbreviation for fiber distributed data interface.*

FDDI-2: *See fiber distributed data interface.*

FDHM: *See full width at half maximum.*

FDM: *Abbreviation for frequency-division multiplexing.*

FDMA: *Abbreviation for frequency-division multiple access.*

FDX: *Abbreviation for full duplex.*

FEC: *Abbreviation for forward error correction.*

Federal Communications Commission: *See FCC.*

Federal Telecommunications System (FTS): A switched long-distance telecommunications service formerly provided for official Federal Government use. *Note:* FTS has been replaced by **Federal Telecommunications Service 2000 (FTS2000)**.

Federal Telecommunications System 2000 service: *See FTS2000.*

feed: **1.** To supply a signal to the input of a system, subsystem, equipment, or component, such as a transmission line or antenna. **2.** A coupling device between an antenna and its transmission line. (188) *Note:* A feed may consist of a distribution network or a primary radiator. **3.** A transmission facility between (a) the point of origin of a signal, such as is generated in a radio or television studio, and (b) the head-end of a distribution facility, such as a broadcasting station in a network. **4.** Pertaining to the function of inserting one thing into another, such as in

a feed horn, paper feed, card feed, and line feed. (188)

feedback: **1.** The return of a portion of the output, or processed portion of the output, of a (usually active) device to the input. (188) *Note 1:* The feedback signal will have a certain magnitude and phase relationship relative to the output signal or the input signal. This relationship can be used to influence the behavior, such as the gain and stability, of the overall circuit. *Note 2:* If the feedback is regenerative (additive), it is called “positive feedback,” which increases gain and distortion, and decreases linearity and stability. *Note 3:* If the feedback is degenerative (subtractive), it is called “negative feedback,” which reduces the gain and distortion, and increases linearity and stability. *Note 4:* Feedback may occur inadvertently, and be detrimental. **2.** Information returned as a response to an originating source.

feeder echo noise: Signal distortion resulting from reflected waves in a transmission line that is many wavelengths long and mismatched at both the generator and the load ends. (188)

feeder link: A radio link from an Earth station at a given location to a space station, or vice versa, conveying information for a space radiocommunication service other than for the fixed-satellite service. The given location may be at a specified fixed point, or at any fixed point within specified areas. [NTIA] [RR]

FEP: *Abbreviation for front-end processor.*

Fermat’s principle: A principle stating that a ray of light follows the path that requires the least time to travel from one point to another, including reflections and refractions that may occur. *Synonym least-time principle.* [From Weik ’89]

fetch protection: [An] AIS-provided restriction to prevent a program from accessing data in another user’s segment of storage. [NIS]

FET photodetector: A photodetector using photogeneration of carriers in the channel region of a field-effect transistor structure to provide photodetection with current gain.

fiber: See **optical fiber**.

fiber amplifier: A device that amplifies an optical signal directly, without the need to convert it to an electrical signal, amplify it electrically, and reconvert it to an optical signal. *Note 1:* One type of fiber amplifier uses a doped fiber (e.g., a fiber doped with erbium), which bears the communication signal, and which is optically pumped with a laser having a high-powered continuous output at an optical frequency slightly higher than that of the communication signal. The signal is intensified by Raman amplification. *Note 2:* Because neither optical-electrical conversion nor electrical amplification takes place, this type of amplifier is well suited for a wide variety of applications, both digital and analog. *Note 3:* Because this type of amplifier does not require extraordinary frequency (wavelength) control of the pumping laser, it is relatively simple. *Synonym* **Raman amplifier**.

fiber axis: The longitudinal center of symmetry of an optical fiber, i.e., the locus of points that are determined by the centers of mechanical symmetry of the outside diameters of fiber cross sections sampled continuously along the length of the fiber.

fiber bandwidth: See **bandwidth (of an optical fiber)**.

fiber buffer: See **buffer (def. #4)**.

fiber cable: See **fiber optic cable**.

fiber cutoff wavelength (λ_c): See **cutoff wavelength (def. #2)**.

fiber dispersion: See **dispersion**.

fiber distributed data interface (FDDI): A concept, defined in ANSI standards, for an optical-fiber-based token-ring network, featuring (a) dual counter-rotating logical rings, each with a data transmission capacity of 100 Mb/s, (b) reliable data transfer, (c) active link monitoring, (d) station management, and (e) survivability features. *Note 1:* The four standards are (a) ANSI X3T9.5, containing Physical Media Dependent (PMD) specifications, (b) ANSI X3T9.5, containing the Physical (PHY) specifications, (c) ANSI X3.139, containing Media Access Control (MAC) specifications, and (d) ANSI X39.5,

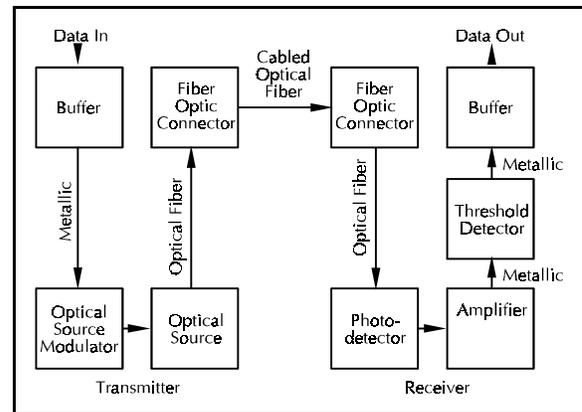
containing the Station Management (SMT) specifications. *Note 2:* The data rate of an FDDI ring may be doubled to 200 Mb/s, with loss of redundancy. *Note 3:* FDDI-2, a second-generation FDDI network standard, is under development.

fiber optic bus: See **bus**.

fiber optic cable: A telecommunications cable in which one or more optical fibers are used as the propagation medium. [After 2196] (188) *Note 1:* The optical fibers are surrounded by buffers, strength members, and jackets for protection, stiffness, and strength. *Note 2:* A fiber-optic cable may be an all-fiber cable, or contain both optical fibers and metallic conductors. One possible use for the metallic conductors is the transmission of electric power for repeaters. [After FAA] *Synonyms* **optical cable**, **optical fiber cable**.

fiber optic isolator: See **optical isolator**.

fiber optic link: A communications link that transmits signals by means of modulated light propagated in an optical fiber. (188)



digital fiber-optic link

fiber optics (FO): The branch of optical technology concerned with the transmission of light through fibers made of transparent materials such as glasses and plastics. (188) [2196] *Note 1:* Telecommunications applications of fiber optics use flexible low-loss fibers, using a single fiber per optical path. Present-day plastic fibers have losses that are too high for telecommunications applications. *Note 2:* Various industrial and medical applications of fiber optics, such as endoscopes, use flexible fiber

bundles in which individual fibers are spatially aligned, permitting optical relay of an image. *Note 3:* Some specialized industrial applications use rigid (fused) aligned fiber bundles for image transfer; such as in the fiber optics faceplates used on some cathode ray tubes (CRTs) to “flatten” the image.

fiber pigtail: *See pigtail (def. #1).*

fidelity: The degree to which a system, or a portion of a system, accurately reproduces, at its output, the essential characteristics of the signal impressed upon its input or the result of a prescribed operation on the signal impressed upon its input. (188)

field: **1.** The volume of influence of a physical phenomenon, expressed vectorially. **2.** On a data medium or in storage, a specified area used for a particular class of data, *e.g.*, a group of character positions used to enter or display wage rates on a screen. **3.** Defined logical data that are part of a record. **4.** The elementary unit of a record that may contain a data item, a data aggregate, a pointer, or a link. **5.** In an interlaced, raster-scanned video display, a partial frame, consisting of every *n*th scanning line of a complete frame, where *n* is an integer equal to the number of fields (usually two) in a complete frame. *Note 1:* For example, in the National Television Standards Committee (NTSC) television specification used in the United States, a single frame is composed of two fields, each of which has half the number of scanning lines in a complete frame. The scanning lines of a field are separated by twice the space between the scanning lines in the full frame. The two fields are interlaced, *i.e.*, a complete frame consists of the following traces, which are listed in the order of their appearance in the complete frame, but not the order in which scanning occurs: the first line of the first field, the first line of the second field, the second line of the first field, the second line of the second field, the third line of the first field, the third line of the second field, *etc.*, until completion of the full frame. The fields are scanned alternately, one complete field at a time. Thus, the flicker rate of the display is perceived by the eye to be twice as fast as that which would result if the complete frame were to be scanned in line-by-line order. *Note 2:* Not all scanning lines are necessarily applied to user information, *i.e.*, the graphic display. Certain scanning lines, not seen under ordinary viewing conditions, are

often used for transmitting test signals that indicate the quality of the displayed video.

field-disturbance sensor: A restricted radiation device which establishes a radio frequency field in its vicinity and detects changes in that field resulting from the movement of persons or objects within the radio frequency field. Examples: microwave intrusion sensors; devices that use rf energy for production line counting and sensing. [NTIA]

field intensity: The irradiance of an electromagnetic wave under specified conditions. (188) *Note:* Field intensity is usually expressed in watts per square meter.

field strength: The magnitude of an electric, magnetic, or electromagnetic field at a given point. (188) *Note:* The field strength of an electromagnetic wave is usually expressed as the rms value of the electric field, in volts per meter. The field strength of a magnetic field is usually expressed in ampere-turns per meter or in oersteds. *Synonym radio field intensity.*

field wire: A flexible insulated wire used in field telephone and telegraph systems. (188) *Note 1:* WD-1 and WF-16 are types of field wire. *Note 2:* Field wire usually contains conductors and high-tensile-strength strands serving as strength members.

FIFO: *Abbreviation for first-in first-out.*

file: **1.** The largest unit of storage structure that consists of a named collection of all occurrences in a database of records of a particular record type. **2.** A set of related records treated as a unit, for example, in stock control, a file could consist of a set of invoices.

file server: **1.** A high-capacity disk storage device or a computer that each computer on a network can use or access and retrieve files that can be shared among attached computers. **2.** A program, running on a computer, that allows different programs, running on other computers, to access the files of that computer.

file transfer, access, and management (FTAM): An application's service and protocol based on the concept of virtual file store. *Note:* FTAM allows remote access to various levels in a file structure and

provides a comprehensive set of file management capabilities.

File Transfer Protocol (FTP): *See* **FTP**.

fill: *See* **bit stuffing**.

fill bit: *See* **bit stuffing**.

filled cable: A cable that has a nonhygroscopic material, usually a gel, inside the jacket or sheath. (188) *Note 1:* The nonhygroscopic material fills the spaces between the interior parts of the cable, preventing moisture from entering minor leaks in the sheath and migrating inside the cable. *Note 2:* A metallic cable, such as a coaxial cable or a metal waveguide, filled with a dielectric material, is not considered as a filled cable.

FILO: *Abbreviation for first-in, last-out.*

filter: In electronics, a device that transmits only part of the incident energy and may thereby change the spectral distribution of energy: (a) high-pass filters transmit energy above a certain frequency; (b) low-pass filters transmit energy below a certain frequency; (c) bandpass filters transmit energy of a certain bandwidth; (d) band-stop filters transmit energy outside a specific frequency band. [JP1]

filtered symmetric differential phase-shift keying (FSDPSK): A method of encoding information for digital transmission in which (a) a binary 0 is encoded as a $+90^\circ$ change in the carrier phase and a binary 1 is encoded as a -90° change in the carrier phase, and (b) abrupt phase transitions are smoothed by filtering or other functionally equivalent pulse shaping techniques.

finished call: **1.** In an information transaction, a call in which the call originator or call receiver terminates the communication and goes on hook, *i.e.*, hangs up. **2.** In an information transfer transaction, the termination of the information transfer phase.

FIP: *Acronym for Federal Information Processing.*

FIP equipment: In the Federal Government, any equipment or interconnected system or subsystems of equipment (as defined in 41CFR) used in the

automatic acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information.

FIP system: In the Federal Government, any organized combination of FIP equipment, software, services, support services, or related supplies.

firmware: Software that is embedded in a hardware device that allows reading and executing the software, but does not allow modification, *e.g.*, writing or deleting data by an end user. (188) *Note 1:* An example of firmware is a computer program in a read-only memory (ROM) integrated circuit chip. A hardware configuration is usually used to represent the software. *Note 2:* Another example of firmware is a program embedded in an erasable programmable read-only memory (EPROM) chip, which program may be modified by special external hardware, but not by an application program.

first-in first-out (FIFO): A queuing discipline in which entities in a queue leave the queue in the same order in which they arrive. (188) *Note 1:* Service, when available, is offered to the entity that has been in the FIFO queue the longest. *Note 2:* FIFO techniques are used in message switching.

first-in last-out (FILO): A queuing discipline in which entities in a queue leave the queue in the reverse order from that in which they arrived. (188) *Note:* An understanding of FILO techniques is important in the understanding of store-and-forward capabilities in packing switching.

first window: Of silica-based optical fibers, the transmission window at approximately 830 to 850 nm. [FAA]

FISINT: *Acronym for foreign instrumentation signals intelligence.*

five-hundred (500) service: A telephone service that allows individuals to receive, via a single number, telephone calls in various locations (*e.g.*, home, office, or car phone) from call originators not necessarily using the same common carrier.

fixed access: In personal communications service (PCS), terminal access to a network in which there is

a set relationship between a terminal and the access interface. *Note:* A single “identifier” serves for both the access interface and the terminal. If the terminal moves to another access interface, that terminal assumes the identity of the new interface.

fixed attenuator: *See pad.*

fixed loop: A service feature that permits an attendant on an assisted call to retain connection through the attendant position for the duration of the call. *Note:* The attendant will usually receive a disconnect signal when the call is terminated.

fixed microwave auxiliary station: A fixed station used in connection with (a) the alignment of microwave transmitting and receiving antenna systems and equipment, (b) coordination of microwave radio survey operations, and (c) cue and contact control of television pickup station operations. [47CFR]

fixed-reference modulation: Modulation in which the significant condition for any signal element is based on a fixed reference. (188)

fixed-satellite service: A radiocommunication service between Earth stations at given positions when one or more satellites are used; the given position may be a specified fixed point or any fixed point within specified areas; in some cases this service includes satellite-to-satellite links, which may also be effected in the inter-satellite service, the fixed-satellite service may also include feeder links for other space radiocommunication services. [RR]

fixed service (FX): A radiocommunication service between specified fixed points. [NTIA] [RR]

fixed station: A station in the fixed service. [NTIA] [RR]

fixed storage: *Synonym read-only storage.*

fixed-tolerance-band compaction: Data compaction accomplished by storing or transmitting data only when the data fall outside prescribed limits. *Note:* An example of fixed-tolerance-band compaction in a telemetering system is the transmission of the temperature only when the temperature is above or below preestablished threshold limits. Thus, the

recipient of the transmission is to assume that the value is in the prescribed range unless a signal to the contrary occurs. [From Weik '89]

flag: In data transmission or processing, an indicator, such as a signal, symbol, character, or digit, used for identification. *Note:* A flag may be a byte, word, mark, group mark, or letter that signals the occurrence of some condition or event, such as the end of a word, block, or message.

flag sequence: In data transmission or processing, a sequence of bits used to delimit, *i.e.* mark, the beginning and end of a frame. *Note 1:* An 8-bit sequence is usually used as the flag sequence; for example, the 8-bit flag sequence 01111110. *Note 2:* Flag sequences are used in bit-oriented protocols, such as Advanced Data Communication Control Procedures (ADCCP), Synchronous Data Link Control (SDLC), and High-Level Data Link Control (HDLC).

flash: A signal generated by the momentary depression of the telephone switchhook or other device. *Note:* A flash may be used to request additional services.

FLASH message: A category of precedence reserved for initial enemy contact messages or operational combat messages of extreme urgency. Brevity is mandatory. [JP1]

flat fading: Fading in which all frequency components of a received radio signal vary in the same proportion simultaneously. (188)

flat rate service: Telephone service in which a single payment permits an unlimited number of local calls to be made without further charge for a specified period of time.

flat weighting: In a noise-measuring set, a noise weighting based on an amplitude-frequency characteristic that is flat over a frequency range that must be stated. (188) *Note 1:* Flat noise power is expressed in dBm ($f_1 - f_2$) or in dBm ($f_1 - f_2$). *Note 2:* “3-kHz flat weighting” and “15-kHz flat weighting” are based on amplitude-frequency characteristics that are flat between 30 Hz and the frequency indicated.

F layer: *See F region.*

Fleming's rule: A rule stating that if the thumb of the right hand points in the direction of an electric current, then the curled fingers point in the direction of the magnetic field that encircles the current; and further, if the curled fingers of the right hand describe the electric current in a solenoid, then the thumb points in the direction of the magnetic field inside the solenoid. *Synonym* **right-hand rule.** [From Weik '89]

flexible disk: *Synonym* **diskette.**

flip-flop: A device that may assume either one of two reversible, stable states. *Note 1:* The flip-flop is used as a basic control element in computer and communications systems. *Note 2:* In a flip-flop, the transition from one stable state to the other is unstable, *i.e.*, for the very short period during which the transition takes place, both outputs may assume the same state, which state may be unpredictable. *Synonyms* **bistable circuit, bistable multivibrator, bistable trigger circuit.**

floating-point coding compaction: Data compaction accomplished by using coefficients, a base, and exponents to specify the scale, range, or magnitude of numbers. *Note:* An example of floating-point coding compaction is using 119.8×10^6 , 119.8(6), or 119.86 to represent 119,800,000. If the number is rounded to 120,000,000, it might be written as 1206 or 127 in which the last digit is the number of zeros to be appended to the preceding digits. Thus, only three positions are required instead of nine to represent the number in storage or in a message, which is only 33% of the original space and time requirement. [From Weik '89]

flooding compound: A substance surrounding the buffer tubes of a fiber-optic cable, to prevent water intrusion into the interstices in the event of a breach of the jacket. [FAA]

flood projection: In facsimile, the optical method of scanning in which the object is floodlighted and the scanning spot is defined by a masked portion of the illuminated area.

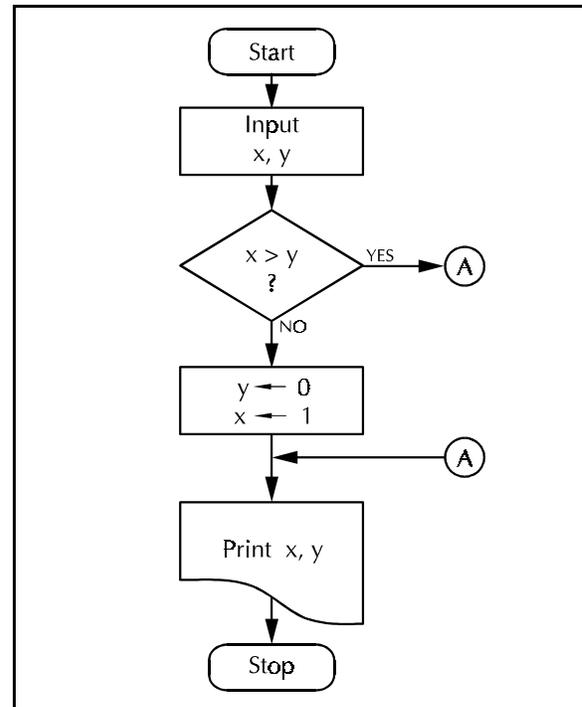
flood search routing: In a telephone network, nondeterministic routing in which a dialed number received at a switch is transmitted to all switches, *i.e.*,

flooded, in the area code directly connected to that switch; if the dialed number is not an affiliated subscriber at that switch, the number is then retransmitted to all directly connected switches, and then routed through the switch that has the dialed number corresponding to the particular user end instrument affiliated with it. *Note 1:* All digits of the numbering plan are used to identify a particular subscriber. *Note 2:* Flood search routing allows subscribers to have telephone numbers independent of switch codes. *Note 3:* Flood search routing provides the highest probability that a call will go through even though a number of switches and links fail.

floppy disk: *Synonym* **diskette.**

flops: *Acronym for floating-point operations per second.* *Note:* For example, 15 Mflops equals 15 million floating-point arithmetic operations per second. [From Weik '89]

flowchart: A graphical representation in which symbols are used to represent such things as operations, data, flow direction, and equipment, for the definition, analysis, or solution of a problem. *Synonym* **flow diagram.**



flowchart

flow control: *See transmit flow control.*

flow control procedure: A procedure for controlling the rate of transfer of data among elements of a network, *e.g.*, between a DTE and a data switching exchange network, to prevent overload.

flow diagram: *Synonym flowchart.*

flowline: On a flowchart, a line that (a) has an indicated direction, (b) represents a connection between other symbols, and (c) indicates the sequence of operations or the transfer of control.

flutter: Rapid variation of signal parameters, such as amplitude, phase, and frequency. (188) *Note:* Examples of flutter are (a) rapid variations in received signal levels, such as variations that may be caused by atmospheric disturbances, antenna movements in a high wind, or interaction with other signals, (b) in radio propagation, a phenomenon in which nearly all radio signals that are usually reflected by ionospheric layers in or above the E-region experience partial or complete absorption, (c) in radio transmission, rapidly changing signal levels, together with variable multipath time delays, caused by reflection and possible partial absorption of the signal by aircraft flying through the radio beam or common scatter volume, (d) the variation in the transmission characteristics of a loaded telephone circuit caused by the action of telegraph direct currents on the loading coils, (e) in recording and reproducing equipment, the deviation of frequency caused by irregular mechanical motion, *e.g.*, that of capstan angular velocity in a tape transport mechanism, during operation.

flux: 1. The lines of force of a magnetic field. **2.** *Obsolete synonym for radiant power.*

flywheel effect: In an oscillator, the continuation of oscillations after removal of the control stimulus. (188) *Note 1:* The flywheel effect is usually caused by interacting inductive and capacitive circuits in the oscillator. *Note 2:* The flywheel effect may be desirable, such as in phase-locked loops used in synchronous systems, or undesirable, such as in voltage-controlled oscillators. *Synonym flywheeling.*

flywheeling: *Synonym flywheel effect.*

FM: *Abbreviation for frequency modulation.*

FM blanketing: That form of interference to the reception of other broadcast stations, which is caused by the presence of an FM broadcast signal of 115 dB μ (562 mV/m) or greater signal strength in the area adjacent to the antenna of the transmitting station. The 115-dBu contour is referred to as the “blanketing area.” [47CFR]

FM broadcast translator: *See translator (def. #3).*

FM capture effect: *Synonym capture effect.*

FM capture ratio: *See capture effect.*

FM improvement factor: The quotient obtained by dividing the signal-to-noise ratio (SNR) at the output of an FM receiver by the carrier-to-noise ratio (CNR) at the input of the receiver. *Note:* When the FM improvement factor is greater than unity, the improvement in the SNR is always obtained at the expense of an increased bandwidth in the receiver and the transmission path. (188)

FM improvement threshold: The point in an FM receiver at which the peaks in the rf signal equal the peaks of the thermal noise generated in the receiver. (188) *Note:* A baseband signal-to-noise ratio of about 30 dB is typical at the improvement threshold, and this ratio improves 1 dB for each decibel of increase in the signal above the threshold.

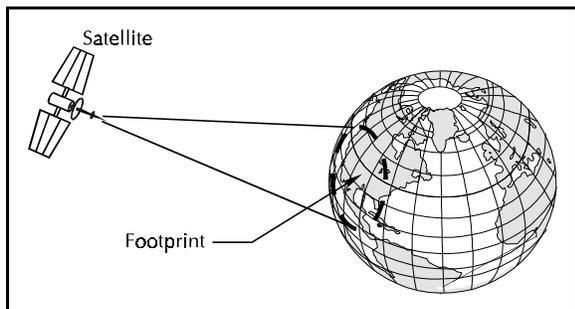
FM threshold effect: In an FM receiver, the effect produced when the desired-signal gain begins to limit the desired signal, and thus noise limiting (suppression). (188) *Note:* FM threshold effect occurs at (and above) the point at which the FM signal-to-noise improvement is measured.

FM threshold extension: A change in the value of the FM threshold of a receiver. *Note:* FM threshold extension may be obtained by decreasing the operational bandwidth, thus decreasing the received noise power and allowing the threshold of the desired signal to occur at a lower signal input level.

FO: *Abbreviation for fiber optics.*

footprint: In satellite communications, that portion of the Earth’s surface over which a satellite antenna

delivers a specified amount of signal power under specified conditions. (188) *Note:* The limiting case of footprint area is somewhat less than one-half the Earth's surface, and depends on the altitude of the satellite.



footprint

forbidden character: *Synonym illegal character.*

foreign exchange (FX) service: A network-provided service in which a telephone in a given local exchange area is connected, via a private line, to a central office in another, *i.e.*, “foreign”, exchange, rather than the local exchange area's central office. *Note:* To call originators, it appears that the subscriber having the FX service is located in the foreign exchange area.

foreign instrumentation signals intelligence (FISINT): 1. Intelligence information derived from electromagnetic emissions associated with the testing and operational deployment of foreign aerospace, surface, and subsurface systems. 2. Technical information and intelligence information derived from the intercept of foreign instrumentation signals by other than the intended recipients. Foreign instrumentation signals intelligence is a category of signals intelligence. *Note:* Foreign instrumentation signals include but are not limited to signals from telemetry, beaconry, electronic interrogators, tracking/fusing/arming/firing command systems, and video data links. [JP1]

format: 1. The arrangement of bits or characters within a group, such as a word, message, or language. (188) 2. The shape, size, and general makeup of a document. (188)

Fortran: *See language processor.*

fortuitous conductor: Any conductor that may provide an unintended path for signals. *Note:* Examples of fortuitous conductors are water pipes, wires, cables, and metal building and equipment structural members. (188)

fortuitous distortion: Distortion resulting from causes generally subject to laws concerning random occurrences. (188)

forward busying: In a telecommunications system, a feature in which supervisory signals are forwarded in advance of address signals in order to seize assets of the system before attempting to establish a connection. (188)

forward channel: The channel of a data circuit that transmits data from the originating user to the destination user. *Note:* The forward channel carries message traffic and some control information.

forward echo: In a transmission line, an echo propagating in the same direction as the original wave and consisting of energy reflected back by one discontinuity and then forward again by another discontinuity. (188) *Note:* Forward echoes can be supported by reflections caused by splices or other discontinuities in the transmission medium (*e.g.*, optical fiber, twisted pair, or coaxial tube). In metallic lines, they may be supported by impedance mismatches between the source or load and the characteristic impedance of the transmission medium.

forward error correction (FEC): A system of error control for data transmission wherein the receiving device has the capability to detect and correct any character or code block that contains fewer than a predetermined number of symbols in error. (188) *Note:* FEC is accomplished by adding bits to each transmitted character or code block, using a predetermined algorithm.

forward propagation ionospheric scatter (FPIS): *Synonym ionospheric scatter.*

forward scatter: The deflection—by diffraction, nonhomogeneous refraction, or nonspecular reflection by particulate matter of dimensions that are large with respect to the wavelength in question but small with respect to the beam diameter—of a portion of an incident electromagnetic wave, in such a manner that

the energy so deflected propagates in a direction that is within 90° of the direction of propagation of the incident wave. *Note:* The scattering process may be polarization-sensitive, *i.e.*, incident waves that are identical in every respect but their polarization may be scattered differently.

forward signal: A signal sent in the direction from the calling to the called station, *i.e.*, from the original data source to the original data sink. *Note:* The forward signal is transmitted in the forward channel.

FOT: *Abbreviation for frequency of optimum transmission.* In the transmission of radio waves via ionospheric reflection, the highest effective, *i.e.*, working, frequency that is predicted to be usable for a specified path and time for 90% of the days of the month. (188) *Note 1:* The FOT is normally just below the value of the maximum usable frequency (MUF). In the prediction of usable frequencies, the FOT is commonly taken as 15% below the monthly median value of the MUF for the specified time and path. *Note 2:* The FOT is usually the most effective frequency for ionospheric reflection of radio waves between two specified points on Earth. *Synonyms* **frequency of optimum traffic, optimum traffic frequency, optimum transmission frequency, optimum working frequency.**

Fourier analysis: The definition of a periodic waveform of arbitrary shape as a summation of sine waves having specific amplitudes and phases, and having frequencies corresponding to the harmonics of the waveform being defined. *Note:* A Fourier analysis is particularly well suited for communications equipment design and for predicting the performance of a given design. [From Weik '89]

four-wire circuit: A two-way circuit using two paths so arranged that the respective signals are transmitted in one direction only by one path and in the other direction by the other path. *Note:* The four-wire circuit gets its name from the fact that, historically, two conductors were used in each of two directions for full-duplex operation. The name may still be applied, *e.g.*, to a communications link supported by optical fibers, even though only one fiber is required for transmission in each direction. *Contrast with* **two-wire circuit.** (188)

four-wire repeater: A repeater, consisting of two amplifiers, one associated with each direction, used in a four-wire circuit. (188)

four-wire terminating set: A balanced transformer used to perform a conversion between 4-wire and 2-wire operation. *Note 1:* For example, a 4-wire circuit may, by means of a 4-wire terminating set, be connected to a 2-wire telephone set. Also, a pair of 4-wire terminating sets may be used to introduce an intermediate 4-wire loop into a 2-wire circuit, in which loop repeaters may be situated to amplify signals in each direction without positive feedback and oscillation. *Note 2:* Four-wire terminating sets have been largely supplanted by resistance hybrids. (188)

fox message: A standard test message that includes all the alphanumeric characters on a teletypewriter and also function characteristics (space, figures shift, letters shift). *Note:* An example of a fox message is "THE QUICK BROWN FOX JUMPED OVER THE LAZY DOG'S BACK 1234567890."(188)

FPIS: *Abbreviation for forward propagation ionospheric scatter. See ionospheric scatter.*

fractional frequency fluctuation: The deviation of the frequency of an oscillator from its nominal constant frequency, normalized to the nominal frequency.

fractional T1: In the North American or Japanese hierarchies, the tariffed use of a data rate corresponding to fewer than the 24 channels served by a T1 line.

frame: **1.** In data transmission, the sequence of contiguous bits delimited by, and including, beginning and ending flag sequences. *Note 1:* A frame usually includes an information field, and usually consists of a specified number of bits between flags and contains an address field, a control field, a frame check sequence, and flags. *Note 2:* Frames usually consist of a representation of the original data to be transmitted, together with other bits which may be used for error detection or control. Additional bits may be used for routing, synchronization, or overhead information not directly associated with the original data. **2.** In the multiplex structure of pulse-code

modulation (PCM) systems, a set of consecutive time slots in which the position of each digit can be identified by reference to a frame-alignment signal. (188) *Note:* The frame-alignment signal does not necessarily occur, in whole or in part, in each frame. **3.** In a time-division multiplexing (TDM) system, a repetitive group of signals resulting from a single sampling of all channels, including any required system information, such as additional synchronizing signals. (188) *Note:* “*In-frame*” is the condition that exists when there is a channel-to-channel and bit-to-bit correspondence, exclusive of transmission errors, between all inputs of a time-division multiplexer and the output of its associated demultiplexer. **4.** In ISDN, a block of variable length, labeled at the Data Link Layer of the Open Systems Interconnection—Reference Model. **5.** In video display, the set of all picture elements that represent one complete image. (188) *Note:* In NTSC and other television standards used throughout the world, a frame consists of two interlaced fields, each of which has half the number of scanning lines, and consequently, half the number of pixels, of one frame. **6.** In video display, one complete scanned image from a series of video images. *Note:* A video frame is usually composed of two interlaced fields.

frame alignment: In the reception of framed digital data, the extent to which a received frame is correctly aligned with respect to the clock at the receiver.

frame-alignment recovery time: *Synonym reframing time.*

frame alignment signal: In the transmission of data frames, a distinctive sequence of bits used to accomplish frame alignment. *Note:* A frame alignment signal may also contain additional bits for status, control, and error detection. (188)

frame-alignment time slot : A time slot starting at a particular phase or instant in each frame and allocated to the transmission of a frame-alignment signal. (188)

frame check sequence (FCS): *See cyclic redundancy check.*

framed interface: An interface through which information flow is partitioned into physical, periodic frames consisting of overhead information and an information payload.

frame duration: The time between the beginning of a frame and the end of that frame. *Note:* For fixed-length frames, at a fixed data rate, frame duration is constant.

frame frequency: *Synonym frame rate.*

frame grabber: A device that can seize and record a single frame of video information out of a sequence of many frames.

frame pitch: The distance, time, or number of bits between corresponding points, *i.e.*, significant instants, in two consecutive frames. [From Weik '89]

frame rate: The number of frames transmitted or received per unit time. (188) *Note 1:* The frame rate is usually expressed in frames per second. *Note 2:* In television transmission, the frame rate must be distinguished from the field rate, which in the NTSC and other systems, is twice the frame rate. *Synonym frame frequency.*

frame relay: An interface protocol for statistically multiplexed packet-switched data communications in which (a) variable-sized packets (frames) are used that completely enclose the user packets they transport, and (b) transmission rates are usually between 56 kb/s and 1.544 Mb/s (the T-1 rate). *Note 1:* In frame relay, (a) there is neither flow-control nor an error-correction capability, (b) there is information-content independence, (c) there is a correspondence only to the ISO Open systems Interconnection—Reference Model Layers 1 and 2, (d) variable-sized user packets are enclosed in larger packets (frames) that add addressing and verification information, (e) frames may vary in length up to a design limit, usually 1 kilobyte or more, (f) one frame relay packet transports one user packet, (g) implementation of fast-packet technology is used for connection-oriented frame relay services, and (h) there is a capability to handle time-delay insensitive traffic, such as LAN interworking and image transfer. *Note 2:* Frame relay is referred to as the *local management interface (LMI) standard* and is specified in *ANSI T1.617*.

frame slip: In the reception of framed data, the loss of synchronization between a received frame and the receiver clock, causing a frame misalignment event, and resulting in the loss of the data contained in the

received frame. (188) *Note:* A frame slip should not be confused with a dropped frame where synchronization is not lost, *e.g.*, in the case of buffer overflow.

frame synchronization: Of a received stream of framed data, the process by which incoming frame alignment signals, *i.e.*, distinctive bit sequences, are identified, *i.e.*, distinguished from data bits, permitting the data bits within the frame to be extracted for decoding or retransmission. *Note:* The usual practice is to insert, in a dedicated time slot within the frame, a noninformation bit that is used for the actual synchronization of the incoming data with the receiver. *Synonym framing (def. #1).*

frame synchronization pattern: In digital communications, a prescribed recurring pattern of bits transmitted to enable the receiver to achieve frame synchronization. (188)

framing: **1.** In time-division multiplexing reception, *synonym frame synchronization.* (188) **2.** In video reception, the process of adjusting the timing of the receiver to coincide with the received video synchronization pulse. **3.** In facsimile, the adjustment of the facsimile picture to a desired position in the direction of line progression. (188)

framing bit: **1.** A bit used for frame synchronization. **2.** In a bit stream, a bit used in determining the beginning or end of a frame. *Note 1:* The framing bit occurs at a specific position in the frame. (188) *Note 2:* In a bit stream, framing bits are noninformation bits. *Note 3:* Framing in a digital signal is usually repetitive.

framing signal: *See frame-alignment signal, framing bit.*

Fraunhofer diffraction pattern: *Synonym far-field diffraction pattern.*

Fraunhofer region: *Synonym far-field region.*

free net: A radio net in which any station may communicate with any other station in the net without first obtaining the permission of the net-control station. *Note:* Permission to operate as a free net is granted by the net-control station until such time as a

directed net is established by the net-control station. [From Weik '89]

free routing: The routing of messages in such a manner that they are forwarded toward their destination or addressee over any available channel without dependence upon predetermined routing. [From Weik '89]

free-running capability: In a synchronized oscillator, the capability to operate in the absence of a synchronizing signal.

free space: A theoretical concept of space devoid of all matter. (188) *Note:* Free space also implies remoteness from material objects that could influence the propagation of electromagnetic waves.

free-space coupling: Coupling of magnetic, electric, or electromagnetic fields that are not confined to a conductor. (188) *Note:* Coupling by the deliberate introduction of capacitors and inductors is not considered free-space coupling.

free-space loss: The signal attenuation that would result if all absorbing, diffracting, obstructing, refracting, scattering, and reflecting influences were sufficiently removed so as to have no effect on propagation. (188) *Note:* Free-space loss is primarily caused by beam divergence, *i.e.*, signal energy spreading over larger areas at increased distances from the source.

freeze frame: A frame of visual information that is selected from a set of motion video frames, and is held in a buffer. (188) *Contrast with still video.*

freeze frame television: Television in which fixed ("still") images are transmitted sequentially at a rate far too slow to be perceived as continuous motion by human vision. *Note:* Transmission of an image is usually performed periodically by a processing unit that contains memory in which data representing the image are stored. For an image of specified quality, *e.g.*, resolution and color fidelity, freeze-frame television has a lower bandwidth requirement than that of full-motion television.

F region: That portion of the ionosphere existing between approximately 160 and 400 km above the surface of the Earth, consisting of layers of increased

free-electron density caused by the ionizing effect of solar radiation. *Note 1:* The F region reflects normal-incident frequencies at or below the critical frequency (approximately 10 MHz) and partially absorbs waves of higher frequency. *Note 2:* The F_1 layer exists from about 160 to 250 km above the surface of the Earth and only during daylight hours. Though fairly regular in its characteristics, it is not observable everywhere or on all days. The principal reflecting layer during the summer for paths of 2,000 to 3,500 km is the F_1 layer. The F_1 layer has approximately 5×10^5 e/cm³ (free electrons per cubic centimeter) at noontime and minimum sunspot activity, and increases to roughly 2×10^6 e/cm³ during maximum sunspot activity. The density falls off to below 10^4 e/cm³ at night. *Note 3:* The F_1 layer merges into the F_2 layer at night. *Note 4:* The F_2 layer exists from about 250 to 400 km above the surface of the Earth. The F_2 layer is the principal reflecting layer for HF communications during both day and night. The horizon-limited distance for one-hop F_2 propagation is usually around 4,000 km. The F_2 layer has about 10^6 e/cm³. However, variations are usually large, irregular, and particularly pronounced during magnetic storms.

frequency: For a periodic function, the number of cycles or events per unit time. (188)

frequency accuracy: The degree of conformity to a specified value of a frequency. (188)

frequency aging: Of an oscillator, the change in frequency, over time, caused by internal changes in oscillator parameters even when external factors, such as environment and power supply characteristics, are constant.

frequency allocation: *See* **allocation (of a frequency band)**.

frequency allotment: *See* **allotment (of a radio frequency or radio frequency channel)**.

frequency-analysis compaction: Data compaction accomplished by using an expression composed of a number of different frequencies of different magnitudes to represent a particular curve. *Note:* An example of frequency-analysis compaction is the use of a Fourier analysis to represent an arbitrary curve, a periodic function, an aperiodic function, or a wave

shape. Thus, the fundamental frequency, the amplitude of the fundamental frequency, and the amplitudes and frequencies of the harmonics are all that are needed to reconstitute the function or wave shape. The shape can thus be readily stored and transmitted in this compacted form. [From Weik '89]

frequency assignment: **1.** Authorization, given by an Administration, for a radio station to use a radio frequency or radio frequency channel under specified conditions **2.** The process of authorizing a specific frequency, group of frequencies, or frequency band to be used at a certain location under specified conditions, such as bandwidth, power, azimuth, duty cycle, or modulation. (188) *Synonym* **radio frequency channel assignment.** *See* **administration (def. #1).**

frequency assignment authority: The power granted an Administration, or its designated or delegated leader or agency via treaty or law, to specify frequencies, or frequency bands, in the electromagnetic spectrum for use in systems or equipment. *Note:* Primary frequency assignment authority for the United States is exercised by the National Telecommunications and Information Administration (NTIA) for the Federal Government and by the Federal Communications Commission (FCC) for non-Federal Government organizations. International frequency assignment authority is vested in the International Frequency Registration Board of the International Telecommunication Union. [Extracted from NTIA]

frequency averaging: **1.** The process by which the relative phases of precision clocks are compared for the purpose of defining a single time standard. **2.** A process in which network synchronization is achieved by use, at all nodes, of oscillators that adjust their frequencies to the average frequency of the digital bit streams received from connected nodes. *Note:* In frequency averaging, all oscillators are assigned equal weight in determining the ultimate network frequency. (188)

frequency band: *See* **electromagnetic spectrum.**

frequency band allocation: *See* **allocation (of a frequency band)**.

frequency-change signaling: A signaling method in which one or more discrete frequencies correspond to each desired significant condition of a code. *Note 1:* The transition from one set of frequencies to the other may be a continuous or a discontinuous change in frequency or in phase. *Note 2:* Frequency-change signaling may be used in both supervisory signaling and data transmission. (188)

frequency coherence: See **phase coherence**.

frequency compatibility: **1.** Of an electronic device, the extent to which it will operate at its designed performance level in its intended operational environment (including the presence of interference) without causing interference to other devices. **2.** The degree to which an electrical or electronic device or devices operating on or responding to a specified frequency or frequencies is capable of functioning with other such devices.

frequency departure: An unintentional deviation from the nominal frequency value.

frequency-derived channel: A channel derived by dividing an allocated or available bandwidth over a medium into two or more portions, each usable separately. (188) *Note:* A frequency-derived channel is continuously available and may be further divided on either a frequency or time basis.

frequency deviation: **1.** The amount by which a frequency differs from a prescribed value, such as the amount an oscillator frequency drifts from its nominal frequency. **2.** In frequency modulation, the absolute difference between (a) the maximum permissible instantaneous frequency of the modulated wave or the minimum permissible instantaneous frequency of the modulated wave and (b) the carrier frequency. **3.** In frequency modulation, the maximum absolute difference, during a specified period, between the instantaneous frequency of the modulated wave and the carrier frequency. (188)

frequency dispersal: An electronic counter-countermeasure (ECCM) in which communications nets' operating frequencies are widely separated from each other, causing a requirement to spread jamming power over wider frequency bands and thus compelling a reduction of available jamming power on any single channel or frequency, or causing a

requirement for more jamming power or more jamming equipment. [From Weik '89]

frequency displacement: The end-to-end shift in frequency that may result from independent frequency translation errors in a circuit. (188)

frequency distortion: *Synonym* **amplitude-vs.-frequency distortion**.

frequency diversity: Transmission and reception in which the same information signal is transmitted and received simultaneously on two or more independently fading carrier frequencies. (188)

frequency-division multiple access (FDMA): The use of frequency division to provide multiple and simultaneous transmissions to a single transponder. (188)

frequency-division multiplexing (FDM): The deriving of two or more simultaneous, continuous channels from a transmission medium by assigning a separate portion of the available frequency spectrum to each of the individual channels. (188)

frequency drift: An undesired progressive change in frequency with time. (188) *Note 1:* Causes of frequency drift include component aging and environmental changes. *Note 2:* Frequency drift may be in either direction and is not necessarily linear.

frequency-exchange signaling: Frequency-change signaling in which the change from one significant condition to another is accompanied by decay in amplitude of one or more frequencies and by buildup in amplitude of one or more other frequencies. *Note:* Frequency-exchange signaling applies to supervisory signaling and user-information transmission. (188) *Synonym* **two-source frequency keying**.

frequency fluctuation: A short-term variation, with respect to time, of the frequency of an oscillator. *Note:* Frequency fluctuation, $f(t)$, is given by

$$f(t) = \frac{1}{2\pi} \frac{d^2 \theta(t)}{dt^2},$$

where $\theta(t)$ is the phase angle of the sinusoidal wave with respect to time, t .

frequency frogging: 1. The interchanging of the frequencies of carrier channels to accomplish specific purposes, such as to prevent feedback and oscillation, to reduce crosstalk, and to correct for a high frequency-response slope in the transmission line. (188) *Note:* Frequency frogging is accomplished by having modulators, which are integrated into specially designed repeaters, translate a low-frequency group to a high-frequency group, and vice versa. A channel will appear in the low group for one repeater section and will then be translated to the high group for the next section because of frequency frogging. This results in nearly constant attenuation with frequency over two successive repeater sections, and eliminates the need for large slope equalization and adjustments. Singing and crosstalk are minimized because the high-level output of a repeater is at a different frequency than the low-level input to other repeaters. 2. In microwave systems, the alternate use of two frequencies at repeater sites to prevent feedback and oscillation. (188)

frequency guard band: A frequency band deliberately left vacant between two channels to provide a margin of safety against mutual interference. (188)

frequency hopping: [The] repeated switching of frequencies during radio transmission according to a specified algorithm, to minimize unauthorized interception or jamming of telecommunications. [NIS] *Note:* The overall bandwidth required for frequency hopping is much wider than that required to transmit the same information using only one carrier frequency.

frequency-hopping spread spectrum: A signal structuring technique employing automatic switching of the transmitted frequency. Selection of the frequency to be transmitted is typically made in a pseudo-random manner from a set of frequencies covering a band wider than the information bandwidth. The intended receiver would frequency-hop in synchronization with the code of the transmitter in order to retrieve the desired information. [NTIA] [RR] (188) *Note:* In many cases, used as an electronic counter-countermeasure (ECCM) technique.

frequency hour: One frequency used for one hour regardless of the number of transmitters over which it

is simultaneously broadcast by a station during that hour. [47CFR]

frequency instability: *See* frequency stability.

frequency lock: The condition in which a frequency-correcting feedback loop maintains control of an oscillator within the limits of one cycle. (188) *Note:* Frequency lock does not imply phase lock, but phase lock does imply frequency lock.

frequency modulation (FM): Modulation in which the instantaneous frequency of a sine wave carrier is caused to depart from the center frequency by an amount proportional to the instantaneous value of the modulating signal. (188) *Note 1:* In FM, the carrier frequency is called the center frequency. *Note 2:* FM is a form of angle modulation. *Note 3:* In optical communications, even if the electrical baseband signal is used to frequency-modulate an electrical carrier (an "FM" optical communications system), it is still the intensity of the lightwave that is varied (modulated) by the electrical FM carrier. In this case, the "information," as far as the lightwave is concerned, is the electrical FM carrier. The lightwave is varied in intensity at an instantaneous rate corresponding to the instantaneous frequency of the electrical FM carrier. [After FAA]

frequency offset: The difference between the frequency of a source and a reference frequency. (188)

frequency of optimum traffic (FOT): *Synonym* FOT.

frequency of optimum transmission (FOT): *See* FOT.

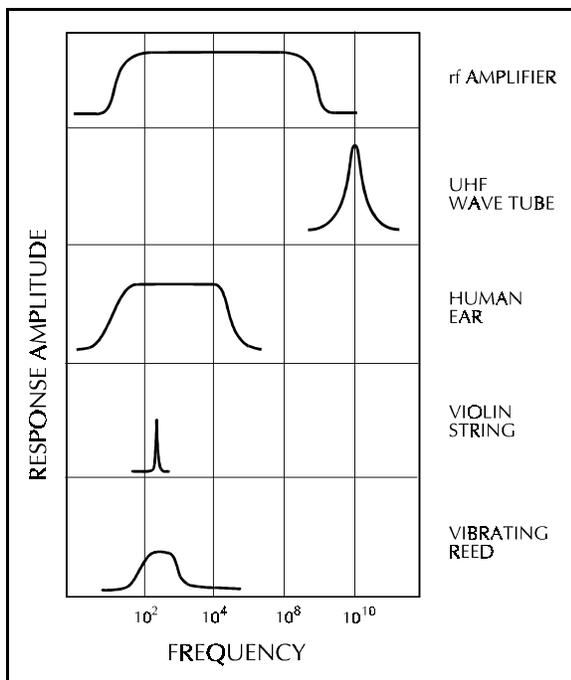
frequency prediction: A prediction of the maximum usable frequency (MUF), the optimum traffic frequency, and the lowest usable frequency (LUF) for transmission between two specific locations or geographical areas during various times throughout a 24-hour period. *Note:* The prediction is usually indicated by means of a graph for each frequency plotted as a function of time. [From Weik '89]

frequency range: A continuous range or spectrum of frequencies that extends from one limiting frequency to another. *Note 1:* The frequency range for given equipment specifies the frequencies at which the

equipment is operable. For example, filters pass or stop certain bands of frequencies. The frequency range for propagation indicates the frequencies at which electromagnetic wave propagation in certain modes or paths is possible over given distances. Frequency allocation, however, is made in terms of bands of frequencies. There is little, if any, conceptual difference between a range of frequencies and a band of frequencies. *Note 2: "Frequency band"* usually identifies a specific band of frequencies in the Tables of Frequency Allocations. [From Weik '89]

frequency response: See **insertion-loss-vs.-frequency characteristic.**

frequency response curve: A plot of the gain or attenuation of a device, such as an amplifier or a filter, as a function of frequency. *Note:* A flat curve indicates a uniform gain or attenuation over the range of frequencies for which the curve is flat. Most amplifiers have a flat frequency response over a certain band, above and below which the gain is reduced. The frequency response curve of a filter has one or more peaks or troughs. [From Weik '89]



representative frequency response of various devices

frequency scanning: Conducting a search for signals over a band or range of frequencies by means of a manually or automatically tuned receiver. *Note:* The tuning rate, *i.e.*, the frequency change rate, may be fixed or variable, or it may be performed mechanically at low speed or electronically at high speed. Frequency scanning may be used to enable a radar to transmit on a clear frequency, *i.e.*, a no-interference frequency, by searching a frequency band and then tuning the system to a clear portion of that band. [From Weik '89]

frequency sharing: The assignment to or use of the same radio frequency by two or more stations that are separated geographically or that use the frequency at different times. *Note 1:* Frequency sharing reduces the potential for mutual interference where the assignment of different frequencies to each user is not practical or possible. *Note 2:* In a communications net, frequency sharing does not pertain to stations that use the same frequency.

frequency shift: **1.** Any change in frequency. **2.** Any change in the frequency of a radio transmitter or oscillator. (188) *Note:* In the radio regime, frequency shift is also called rf shift. **3.** See **frequency-shift telegraphy.** **4.** In facsimile, a frequency modulation system where one frequency represents picture black and another frequency represents picture white. Frequencies between these two limits may represent shades of gray. (188) **5.** An intentional frequency change used for modulation purposes. (188)

frequency-shift keying (FSK): Frequency modulation in which the modulating signal shifts the output frequency between predetermined values. (188) *Note 1:* Usually, the instantaneous frequency is shifted between two discrete values termed the "mark" and "space" frequencies. This is a noncoherent form of FSK. *Note 2:* Coherent forms of FSK exist in which there is no phase discontinuity in the output signal. *Synonyms* **frequency-shift modulation, frequency-shift signaling.**

frequency-shift modulation: *Synonym* **frequency-shift keying.**

frequency-shift signaling: *Synonym* **frequency-shift keying.**

frequency-shift telegraphy: Telegraphy by frequency modulation in which the telegraph signal shifts the frequency of the carrier between predetermined values. [NTIA] [RR]

frequency source: *See* **frequency standard.**

frequency spectrum: *See* **electromagnetic spectrum.**

frequency spectrum congestion: The situation that occurs when many stations transmit simultaneously using frequencies that are close together, *i.e.*, with insufficient width of frequency guard bands or channel spacing. *Note:* Frequency spectrum congestion causes (a) difficulty in discrimination by tuning, (b) overlap of (i) a sideband and an adjacent carrier, or (ii) upper and lower sidebands, respectively, of adjacent carriers, and (c) interference that occurs when frequencies shift slightly or are phase shifted by ionospheric reflection. [From Weik '89]

frequency stability: The degree to which variations of the frequency of an oscillator deviate from the mean frequency over a specified period of time. (188)

frequency standard: A stable oscillator used for frequency calibration or reference. (188) *Note 1:* A frequency standard generates a fundamental frequency with a high degree of accuracy and precision. Harmonics of this fundamental frequency are used to provide reference points. *Note 2:* Frequency standards in a network or facility are sometimes administratively designated as “primary” or “secondary.” The terms “*primary*” and “*secondary*,” as used in this context, should not be confused with the respective technical meanings of these words in the discipline of precise time and frequency.

frequency synthesizer: A device that produces frequencies that are phase coherent with a reference frequency. (188) *Note:* The reference frequency may be derived from an internal or external source.

frequency tolerance: The maximum permissible departure by the center frequency of the frequency band occupied by an emission from the assigned frequency, or by the characteristic frequency of an emission from the reference frequency. Frequency

tolerance is expressed in parts per 10⁶ or in hertz. [NTIA] [RR] (188) *Note:* In the United States, frequency tolerance is expressed in parts per 10ⁿ, in hertz, or in percentages. Frequency tolerance includes both the initial setting tolerance and excursions related to short- and long-term instability and aging.

frequency translation: The transfer of signals occupying a specified frequency band, such as a channel or group of channels, from one portion of the frequency spectrum to another, in such a way that the arithmetic frequency difference of signals within the band is unaltered. (188)

Fresnel diffraction pattern: *Synonym* **near-field diffraction pattern.**

Fresnel reflection: In optics, the reflection of a portion of incident light at a discrete interface between two media having different refractive indices. (188) *Note 1:* Fresnel reflection occurs at the air-glass interfaces at the entrance and exit ends of an optical fiber. Resultant transmission losses, on the order of 4% per interface, can be reduced considerably by the use of index-matching materials. *Note 2:* The coefficient of reflection depends upon the refractive index difference, the angle of incidence, and the polarization of the incident radiation. For a normal ray, the fraction of reflected incident power is given by

$$R = \frac{(n_1 - n_2)^2}{(n_1 + n_2)^2},$$

where R is the reflection coefficient and n_1 and n_2 are the respective refractive indices of the two media. In general, the greater the angle of incidence with respect to the normal, the greater the Fresnel reflection coefficient, but for radiation that is linearly polarized in the plane of incidence, there is zero reflection at Brewster’s angle. *Note 3:* Macroscopic optical elements may be given antireflection coatings consisting of one or more dielectric thin-film layers having specific refractive indices and thicknesses. Antireflection coatings reduce overall Fresnel reflection by mutual interference of individual Fresnel reflections at the boundaries of the individual layers.

Fresnel zone: In radio communications, one of a (theoretically infinite) number of a concentric ellipsoids of revolution which define volumes in the radiation pattern of a (usually) circular aperture. *Note 1:* The cross section of the first Fresnel zone is circular. Subsequent Fresnel zones are annular in cross section, and concentric with the first. *Note 2:* Odd-numbered Fresnel zones have relatively intense field strengths, whereas even numbered Fresnel zones are nulls. *Note 3:* Fresnel zones result from diffraction by the circular aperture. (188)

front-end noise temperature: A measure of the thermal noise generated in the first stage of a receiver. (188)

front-end processor (FEP): A programmed-logic or stored-program device that interfaces data communication equipment with an input/output bus or memory of a data processing computer.

front-to-back ratio: **1.** Of an antenna, the gain in a specified direction, *i.e.*, azimuth, usually that of maximum gain, compared to the gain in a direction 180° from the specified azimuth. *Note:* Front-to-back ratio is usually expressed in dB. **2.** A ratio of parameters used to characterize rectifiers or other devices, in which electrical current, signal strength, resistance, or other parameters, in one direction is compared with that in the opposite direction. (188)

FSDPSK: *Abbreviation for filtered symmetric differential phase-shift keying.*

FSK: *Abbreviation for frequency-shift keying.*

FTAM: *Abbreviation for file transfer, access, and management.*

FTP: *Abbreviation for File Transfer Protocol.* The Transmission Control Protocol/Internet Protocol (TCP/IP) protocol that is (a) a standard high-level protocol for transferring files from one computer to another, (b) usually implemented as an application level program, and (c) uses the Telnet and TCP protocols. *Note:* In conjunction with the proper local software, FTP allows computers connected to the Internet to exchange files, regardless of the computer platform.

FTS: *See FTS2000.*

FTS2000: *Abbreviation for Federal Telecommunications System 2000.* A long distance telecommunications service, including services such as switched voice service for voice or data up to 4.8 kb/s, switched data at 56 kb/s and 64 kb/s, switched digital integrated service for voice, data, image, and video up to 1.544 Mb/s, packet switched service for data in packet form, video transmission for both compressed and wideband video, and dedicated point-to-point private line for voice and data. *Note 1:* Use of FTS2000 contract services is mandatory for use by U.S. Government agencies for all acquisitions subject to 40 U.S.C. 759. *Note 2:* No U.S. Government information processing equipment or customer premises equipment other than that which are required to provide an FTS2000 service are furnished. *Note 3:* The FTS2000 contractors will be required to provide service directly to an agency's terminal equipment interface. For example, the FTS2000 contractor might provide a terminal adapter to an agency location in order to connect FTS2000 ISDN services to the agency's terminal equipment. *Note 4:* GSA awarded two 10-year, fixed-price contracts covering FTS2000 services on December 7, 1988. *Note 5:* The Warner Amendment excludes the mandatory use of FTS2000 in instances related to maximum security. [FIRMR]

full carrier: A carrier that is transmitted without reduction in power, *i.e.*, a carrier that is of sufficient level to demodulate the sideband(s).

full carrier single-sideband emission: A single-sideband emission without reduction of the carrier. [NTIA] [RR]

full-duplex (FDX) circuit: A circuit that permits simultaneous transmission in both directions. (188)

full-duplex (FDX) operation: *Synonym duplex operation.*

full duration at half maximum (FDHM): Full width at half maximum in which the independent variable is time. *See full width at half maximum.*

full modulation: In an analog-to-digital converter, the condition in which the input signal amplitude has just reached the threshold at which clipping begins to occur. [From Weik '89]

full-motion operation: In television, a video frame update rate that provides the appearance of full motion without flicker or smear problems. (188) *Note:* Picture motion appears to be full at greater than 16 fps (frames per second). European television operates at 25 fps and North American television at 30 fps.

full processing: All processing functions required to recover the information bits from a received signal. (188)

full width at half maximum (FWHM): An expression of the extent of a function, given by the difference between the two extreme values of the independent variable at which the dependent variable is equal to half of its maximum value. *Note 1:* FWHM is applied to such phenomena as the duration of pulse waveforms and the spectral width of sources used for optical communications. *Note 2:* The term *full duration at half maximum (FDHM)* is preferred when the independent variable is time.

fully connected mesh network: *See network topology.*

fully connected topology: *See network topology.*

fully intermateable connectors: Connectors from one source that mate with complementary components from other sources without mechanical damage and with transmission properties maintained within specified limits. (188)

functional component (FC): In intelligent networks, an elemental call-processing component that directs internal network resources to perform specific actions, such as collecting dialed digits. *Note:* An FC is unique to the intelligent-network-IN/2 architecture.

functional profile: A standardization document that characterizes the requirements of a standard or group of standards, and specifies how the options and ambiguities in the standard(s) should be interpreted or implemented to (a) provide a particular information technology function, (b) provide for the development of uniform, recognized tests, and (c) promote interoperability among different network elements and terminal equipment that implement a specific profile.

functional signaling: In an integrated services digital network (ISDN), signaling in which the signaling messages are unambiguous and have clearly defined meanings that are known to both the sender and receiver of the messages. *Note:* Functional signaling is usually generated by the data terminal equipment (DTE).

functional signaling link: A combination of a communications link and the associated transfer control functions.

functional unit: An entity of hardware, software, or both, capable of accomplishing a specified purpose.

function signal: A set of signal elements that is used to transmit or represent a function-control character that actuates a control function, such as carriage return, line-feed, letters shift, or figures shift, that is to be performed by communications devices, such as teletypewriters and teleprinters. [From Weik '89]

fundamental: Of a periodic wave, the sinusoidal component, *i.e.*, Fourier component, having the lowest frequency. *Note:* Every periodic waveform may be expressed as the summation of the fundamental and its harmonics. For example, a square wave may be expressed as the summation of sine waves equal in frequency to the fundamental and all odd harmonics, each frequency having an appropriate amplitude and phase. A pure sinusoidal wave has only one component, *i.e.*, the fundamental. *Contrast with harmonic, overtone.*

fundamental mode: The lowest order mode of a waveguide. (188) *Note:* In optical fibers, the fundamental mode is designated LP₀₁ or HE₁₁.

furcate: *Synonym break out.*

fuse: 1. A device that has as its critical component a metal wire or strip that will melt when heated by a prescribed (design) amperage, creating an open in the circuit of which it is a part, thereby protecting the circuit from an overcurrent condition. *Note:* Fuses are often characterized as “fast-blow” or “slow-blow,” according to the time required for them to respond to an overcurrent condition. Fast-blow fuses open nearly instantaneously when exposed to an overcurrent condition. Slow-blow fuses can tolerate

a transient overcurrent condition, but will open if the overcurrent condition is sustained. **2.** In optical fiber technology, to join the endfaces of a pair of optical fibers by melting, *i.e.*, welding, the endfaces together.

fused silica: *Synonym vitreous silica.*

fusion splice: In fiber optics, a splice created by localized heating of the ends of the two fibers to be joined. *Note:* A properly made fusion splice results in a continuous length of material with minimal discontinuities at the splice.

FWHM: *Abbreviation for full width at half maximum.*

FX: *Abbreviation for fixed service, foreign exchange service.*

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